VARIATION IN EUSTREPHUS R. Br. ex Ker Gawler AND GEITONOPLESIUM Cunn. ex R. Br. (ASPARAGALES: LUZURIAGACEAE)

by

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ABSTRACT

Conran, J. G. Variation in *Eustrephus* R. Br. ex Ker Gawler and *Geitonoplesium* Cunn. ex R. Br. (Asparagales: Luzuriagaceae). *Muelleria* 6(5): 363-369 (1987). — The variation of several characters within *Eustrephus latifolius* R. Br. ex Ker Gawler and *Geitonoplesium cymosum* (R. Br.) Cunn. ex R. Br. is studied and found to be continuous. Leaf width in *E. latifolius* and leaf size in *G. cymosum* are found to be clinal with latitude, the average leaf width and length for *G. cymosum* decreasing at higher latitudes and the average leaf width of *E. latifolius* increasing. None of the infraspecific taxa recognised by previous authors are maintained.

INTRODUCTION

Eustrephus R. Br. ex Ker Gawler and *Geitonoplesium* Cunn. ex R. Br. are both monotypic genera in the Luzuriagaceae (Asparagales). They both vary from sub-shrubs to woody climbers, and have been variously included in the Liliaceae (Krause, 1930), Smilacaceae (Cronquist, 1981; Conran and Clifford, 1986), Philesiaceae (Dahlgren and Clifford, 1982) and Luzuriagaceae (Dahlgren *et al.*, 1985). Recent work by Conran (1985) suggests that they are related to the Luzuriagaceae and the Phormiaceae.

Both genera are predominantly eastern Australian, with *Eustrephus* extending to Lord Howe Island, New Caledonia and Papua New Guinea (Fig. 1a), whereas *Geitonoplesium* extends further to Norfolk Is., Fiji, the Solomon Islands and in Malesia to Java (Fig. 1b).

Schlittler (1951) monographed the two genera, providing detailed accounts of their morphology and anatomy in addition to their taxonomy. He recognised, within each species, two subspecies, two varieties, two subvarieties, two forms and two subforms. Examination of material of both genera in the field and under cultivation at Queensland University, and measurements of herbarium accessions suggest that the variants recognised by Schlittler (1951) intergrade and the distinction of infraspecific taxa is unjustified. In their treatment of the Australian Smilacaceae, Conran and Clifford (1986) accepted *Eustrephus* and *Geitonoplesium* as monospecific genera with no infraspecific taxa. This paper substantiates their conclusions in giving a critical assessment of the variation within the characters used by Schlittler to characterise his infraspecific taxa. The synonymies given by Conran and Clifford are amended accordingly.

METHODS AND RESULTS

All specimens identified as *Eustrephus* and *Geitonoplesium* at BRI, BRIU, CANB, CBG, L, MEL and NSW were examined. 125 specimens each of *E. latifolius* R. Br. ex Ker Gawler and *G. cymosum* (R. Br.) Cunn. ex R. Br. from these herbaria were selected, and on each specimen ten leaves were measured for length and maximum width and the results averaged. Correlation coefficients between average leaf length and width, average length and latitude of collection, and average maximum width and latitude were calculated for both species. Scatter diagrams of leaf length against width were plotted for each species, with the specimens graded according to latitude of origin (Fig. 2).

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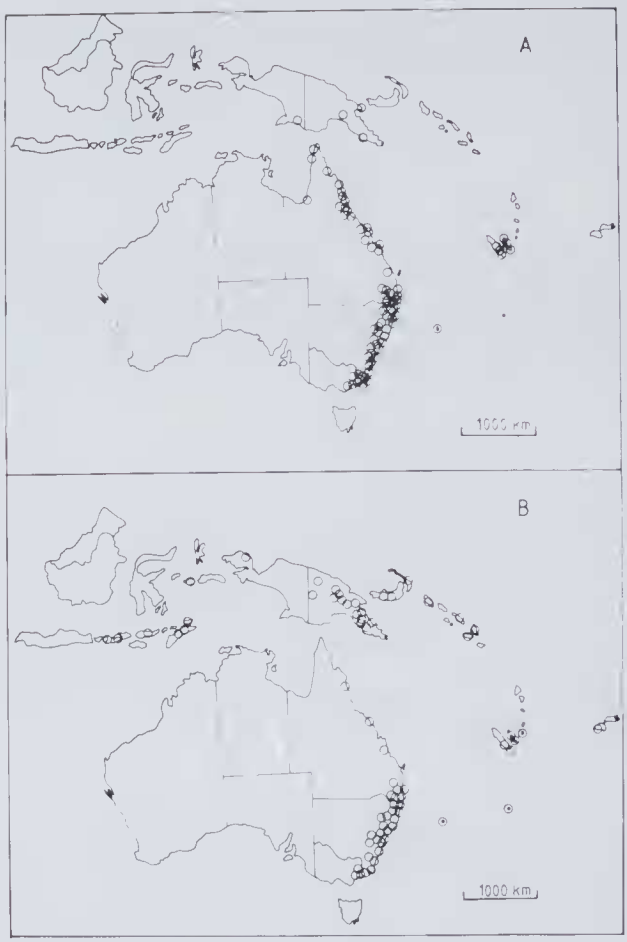

Fig. 1. Geographical distribution of specimens examined. a — Eustrephus latifolius. b — *Geitonoplesium cymosum*.

In *E. latifolius,* a significant positive correlation ($p \geq 0.01$) was found between average leaf width and latitude indicating that as latitude increases, the leaves become progressively broader (Fig. 2a). Leaf width was not, however, significantly correlated with average leaf length, so that the broadening of the leaves was not a result of an overall leaf size increase.

Geitonoplesium cymosum, however, showed a significant positive correlation between average leaf length and width ($p \geq 0.001$), as well as significant negative correlations ($p \geq 0.001$) between both leaf length and width, and latitude. This indicates that the leaves as a whole get smaller at higher latitudes (Fig. 2b).

In addition to the herbarium studies, 10 specimens each of *E. latifolius* and *G. cymosum* were cultivated from field-collected seed from south-east Queensland, under 80% shade in unheated shade frames at Brisbane, and at maturity were transferred to 30% shade. Leaf dimensions were recorded in both sets of conditions, and the same plants were found to produce broad leaves under low light and narrower leaves under high light. Cultivated specimens of the narrow-leaved forms produced broad leaves (c. 8-12mm wide) when grown under low light (c. 80% shade), while the same plants, transferred to 30% shading, produced leaves only 3-4 mm wide.

TAXONOMIC DISCUSSION

Eustrephus

In *E. latifolius,* the variation recognised by Schlittler (1951) consists of variation in leaf shape (subspecies), filament fusion (variety), number of flowers per inflorescence (subvariety), flower colour (form) and degree of tepal fimbriation (subform). Of these infraspecific taxa, only those based on leaf shape are recognised by authors other than Schlittler, although usually at the level of variety (Bailey, 1902; Jacobs and Pickard, 1981).

Schlittler recognised two subspecies: *E. latifolius* subsp. *angustifolius* (R. Br.) Schlittler and *E. latifolius* subsp. *watsonianus* (Miq.) Schlittler on the basis of leaf width. This study does not support such a division, as there is continuous clinal intergradation in leaf width as well as environmentally induced phenotypic variation. While it would be possible to recognise the extreme ends of the cline as subspecies, the majority of the specimens are intermediate in their leaf width, and there is no clear point in the continuum at which a realistic division on leaf width could be made (Fig. 2a).

The varieties recognised by Schlittler were *E. latifolius* var. *brownii* (F. Muell.) Schlittler with the staminal filaments fused into a tube, and *E. latifolius* var. *intermedius* Schlittler with free filaments. The latter taxon is typified by a collection from Batavia, apparently based on a cultivated or naturalised plant since, according to Backer and Backhuizen van den Brink (1968), the species is not native to Java. None of the specimens examined possessed free stamens, although the degree of fusion was variable. The recognition of these varieties does not appear to be warranted, especially when the only known example of free filaments is from a cultivated plant.

Schlittler recognised two subvarieties: *E. latifolius* subvar. *uniflorus* (H. Hallier) Schlittler with single-flowered inflorescences, and *E. latifolius* subvar. *fascicularis* Schlittler with several to numerous flowers. This condition, however, varies depending on the age and general condition of the plants, and individual branches on the same plant may vary considerably in the numbers of flowers produced (from 1-15). These subvarieties are therefore not maintained.

Flower colour was used by Schlittler to separate *E. latifolius* f. *rubens* Schlittler, with pale purple flowers, from *E. latifolius* f. *leucanthus* (Hassk.) Schlittler, with white flowers. Field and culture observations of *E. latifolius* suggest that flower colour and intensity is largely a function of flower age. The flowers open pale mauve, and then gradually fade to white and then pale cream. Individual clones may be darker or paler, but there seems to be a continuum of colour intensity. Thus the forms recognised on flower colour do not seem to be worth maintaining.

Schlittler also recognised two subforms: *E. latifolius* subf. *integerrimus* Schlittler with entire margins of the inner tepals, and *E. latifolius* subf. *fimbriatus* Schlittler with fimbriate margins of the inner tepals. The degree of tepal fimbriation varies to some extent from plant to plant but no plants have been observed where fimbriation was entirely lacking. The type of *E. latifolius* subf. *integerrimus* appears, from its description, to be at the extreme end of the scale of tepal fimbriation, and none of the specimens observed, including those from New Caledonia and other Pacific islands, showed this characteristic. While the maintenance of subform status could possibly be upheld for this isolated variant, the recognition of subforms in what is such an extremely variable species is neither worthwhile nor desirable.

Geitonoplesium

In *G. cymosum,* the variation recognised by Schlittler (1951) consisted of leaf shape (subspecies), inflorescence branching (variety), leaf texture (subvariety), flower colour (form) and stem texture (subform).

As with *Eustrephus,* the subspecies were recognised on the basis of leaf shape: *G. cymosum* subsp. *macrophyllum* Schlittler with broad leaves, and *G. cymosum* subsp. *angustifolium* (Koch) Schlittler with narrow leaves. The leaf shape meas-

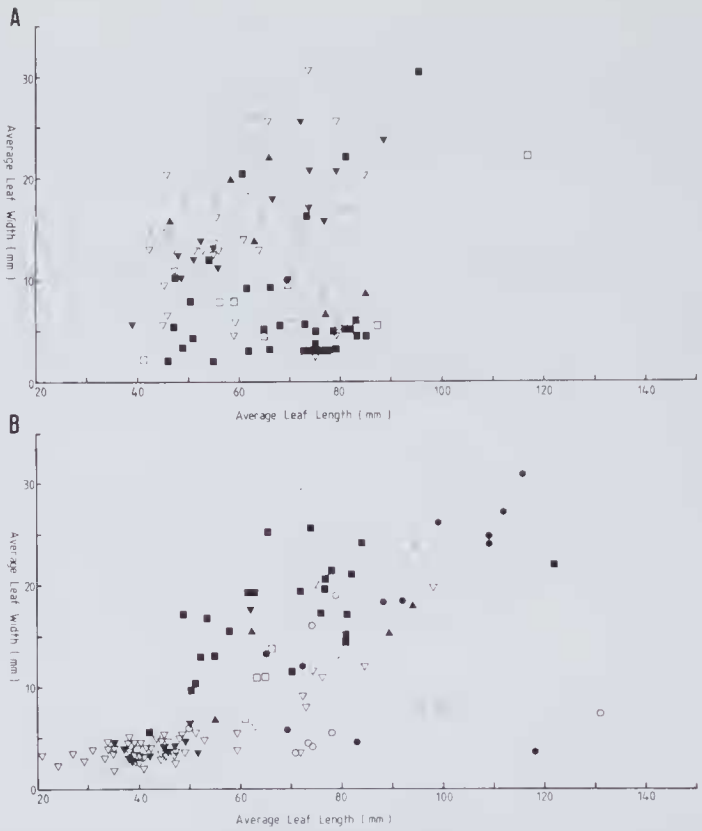

Fig. 2. Scatter diagrams of average leaf length against width showing clinal variation with latitude. a — *Eustrephus latifolius*. b — *Geitonoplesium cymosum*.
○ = 0° - 5° S. △ = > 10°-15° S. □ = > 20°-25° S. ▽ = > 30°-35° S.
● = > 5°-10° S. ▲ = > 15°-20° S. ■ = > 25°-30° S. ▼ = > 35° S.

urements did not support this division, as there was continuous clinal intergradation in leaf size (Fig. 2b), and phenotypic variation under different environmental conditions. Specimens observed in the field and under cultivation in south-east Queensland possessed broad leaves at the base of the plant and progressively narrower leaves along the stems.

The varieties recognised by Schlittler were *G. cymosum* var. *paniculatum* Schlittler and *G. cymosum* var. *timorense* (Ridley) Schlittler on the basis of whether the inflorescence was paniculate or simple. The degree of inflorescence development seems to be related to plant age and general condition, and different parts of the same plant may have simple or compound inflorescences. In his citation of specimens, Schlittler (1951) himself listed several specimens as "var. *timorense* aff. var. *paniculatum*" clearly indicating intergradation. The maintenance of varieties based on the degree of inflorescence branching therefore does not appear to be warranted.

Two subvarieties were recognised by Schlittler: *G. cymosum* subvar. *laxiflorum* (H. Hallier) Schlittler where the (dried) leaves possess inconspicuous venation, and *G. cymosum* subvar. *firmum* Schlittler where the venation is thick and prominent. The thickness, translucency and prominence of the venation in *G. cymosum* leaves is related to leaf age; immature leaves, although fully expanded, lack the thick and prominent veins of older leaves, and are translucent on drying. The degree of exposure to light also affects texture, leaves in high light intensities being more robust. The maintenance of the subvarieties defined by Schlittler therefore seems unwarranted.

The two forms recognised by Schlittler were *G. cymosum* f. *album* Schlittler with greenish-white to yellowish-white flowers, and *G. cymosum* f. *rubellum* Schlittler with dilute purple, pink to greenish-purple flowers. As with *E. latifolius,* flower colour is influenced to a large degree by the age of the flower, but in this case the purple-flowered specimens appear to occur mostly in the northern and Pacific island parts of the range, while the paler-flowered specimens are mostly on the southern, mainland part of the range. The recognition of forms on the basis of flower colour seems to be unnecessary, especially as the two forms intergrade along their geographic ranges, the distinctions are so slight, and each form is so variable.

Stem texture was used by Schlittler to separate subforms, smooth-stemmed plants being regarded as *G. cymosum* subf. *glabrum* Schlittler and plants with a rough stem texture being called *G. cymosum* subf. *asperum* (Cunn.) Schlittler. This feature seems to be highly variable, with older, thicker stems even on otherwise smooth-stemmed plants tending to have rough surfaces. The recognition of these subforms does not appear to be warranted.

GENERAL DISCUSSION

In his discussion of the nomenclature and systematics of the two genera Schlittler (1951) states, with reference to his infraspecific taxa, that:

"The limits are, in each case, arbitrary, there are no sharp boundaries, since they also do not exist in nature." ("Die Begrenzung ist in jedem Fall willkürlich; es gibt keine scharfen Grenzen, weil sie auch in der Nature nicht vorhanden sind.")

He makes it clear that he recognises no "real" biological subunits, and that the infraspecific taxa are intended as alternative names, depending upon which character is used to classify the specimens. However, despite the taxonomic unreality of Schlittler's taxa, their names have been validly published and, as the taxa are not accepted, should be included as synonyms under the names of the two species. Conran and Clifford (1986) regarded Schlittler's infraspecific taxa as "invalid" and "illegitimate" respectively, and failed to list their validly published names in the synonymies. For the sake of completeness, their treatment should be amended to include the names in chronological sequence as synonyms under the two accepted names as follows:

Eustrephus latifolius R. Br. ex Ker Gawler (1809).

E. leucanthus Hassk., Pl. Jav. Rar. Adj. Non. Exot. Jav. Hort. Cult. 115 (1815). — *E. latifolius* f. *leucanthus* (Hassk.) Schlittler, Mitt. Bot. Mus. Univ. Zürich 189: 214 (1951). TYPE: Buitenzorg, Indonesia, *C. A. Backer 31600* (BO n.v.).

Luzuriaga latifolia var *uniflora* H. Hallier, Nova Guinea 8: 993 (1914). — *E. latifolius* subvar. *uniflorus* (H. Hallier) Schlittler, Mitt. Bot. Mus. Univ. Zürich 189: 214 (1951). TYPE: New Guinea, *Koch L15* (L!).

E. latifolius var. *intermedius* Schlittler, Mitt. Bot. Mus. Univ. Zürich 189: 214 (1951). TYPE: Batavia, Weltevreden, Indonesia, *C.A. Backer 26448* (BO n.v.).

E. latifolius subvar. *fasciculatus* Schlittler, Mitt. Bot. Mus. Univ. Zürich 189: 214 (1951). TYPE: Rockingham Bay, Australia, *F. Mueller s.n.* (L!).

E. latifolius f. *rubens* Schlittler, Mitt. Bot. Mus. Univ. Zürich 189: 214 (1951). TYPE: Exemplar cult. Hort. Bogor XC33a (BO n.v.).

E. latifolius subf. *integerrimus* Schlittler, Mitt. Bot. Mus. Univ. Zürich 189: 214 (1951). TYPE: New Caledonia, *M. Plancher s.n.*, 1870 (BO n.v.).

E. latifolius subf. *fimbriatus* Schlittler, Mitt. Bot. Mus. Univ. Zürich 189: 214 (1951). TYPE: Daintree, N. Qld. Australia, *L. J. Brass & C. T. White* 326 (SING *fide* Schlittler loc. cit., now apparently missing).

Geitonoplesium cymosum (R. Br.) Cunn. ex. R. Br. (1832).

Eustrephus timorense Ridley in Forbes, H.O., Naturalists Wanderings E. Archip. 520 (1885). — *G. cymosum* var. *timorense* (Ridley) Schlittler, Mitt. Bot. Mus. Univ. Zürich 189: 228 (1951). TYPE: Timor, Tukskain, *H.O. Forbes 3530* (BO n.v.).

Luzuriaga laxiflora H. Hallier in Lorentz, Nova Guinea 8: 991, t. 180 (1914). — *G. cymosum* subvar. *laxiflorum* (H. Hallier) Schlittler, Mitt. Bot. Mus. Univ. Zürich 189: 228 (1951). TYPE: Hellwig-Gebirge, New Guinea, *Von Römer 932* (L!).

Geitonoplesium cymosum var. *paniculatum* Schlittler, Mitt. Bot. Mus. Univ. Zürich 189: 228 (1951). TYPE: Wissel Lake Region, New Guinea, *P.J. Eyma 5303* (BO, photo only seen).

G. cymosum subvar. *firmum* Schlittler, Mitt. Bot. Mus. Univ. Zürich 189: 228 (1951). TYPE: Wissel Lake Region, *P. J. Eyma 4368* (BO n.v.).

G. cymosum f. *album* Schlittler, Mitt. Bot. Mus. Univ. Zürich 189: 229 (1951). TYPE: Springbrook, Queensland, *C. E. Hubbard 4236* (L!).

G. cymosum f. *rubellum* Schlittler, Mitt. Bot. Mus. Univ. Zürich 189: 229 (1951). TYPE: Guadalacanal Island, *S. F. Kajewski 2641* (BO n.v.).

G. cymosum subf. *glabrum* Schlittler, Mitt. Bot. Mus. Univ. Zürich 189: 229 (1951). TYPE: Soemba, Kanangar, *Grevenst 192* (BO n.v.).

Should any of Schlittler's taxa be accepted in the future, several of the names would need to be synomymised with the autonyms created by the subdivision of the species. The continuous variation within the two species for all the characters and character suites observed does not, however, support any subdivisions within the species. Many of the taxa recognised by Schlittler represent the extreme ends of clines, but there were no places along these clines where any meaningful divisions could be made. The lack of biological reality of Schlittler's taxa (a feature which he realised) supports the relegation of the infraspecific taxa to synonymy, and accordingly none are recognised in this study.

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